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**Workplan Addendum
for
Phase 2 Environmental Site Assessment
of the
Boeing Fabrication Operations Facility
St. Louis, Missouri**

Prepared for:
The Boeing Company
St. Louis, Missouri

Prepared by:
Environmental Science & Engineering, Inc.
St. Louis, Missouri

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List of Acronyms and Abbreviations

ARAR	applicable or relevant and appropriate requirement
CALM	Cleanup Levels for Missouri
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CSF	carcinogenic slope factor
CMs	corrective measures
CMS	Corrective Measures Study
COC	constituent of concern
DCE	dichloroethene
DQL	Data Quality Level
DQO	data quality objective
EQ	Ecotoxicity Quotient
ET	Ecotox Threshold
ESA	Environmental Site Assessment
ft bls	feet below land surface
FR	Federal Register
HASP	Health and Safety Plan
ID	internal diameter
ITL	investigation threshold level
IWTP	Industrial Wastewater Treatment Plant
MCL	maximum contaminant level
MCLG	maximum contaminant level goal
MDNR	Missouri Department of Natural Resources
MEK	methyl ethyl ketone
mg/kg	milligrams per kilogram
MIBK	methyl isobutyl ketone
NCP	National Contingency Plan
PAH	polynuclear aromatic hydrocarbon
PCE	perchloroethylene
ppb	parts per billion
ppm	parts per million
PRG	Preliminary Remediation Goal
QA	quality assurance
QAPP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act

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RFA	RCRA Facility Assessment
RFD	Reference Dose
RFI	RCRA Facility Investigation
SLAPS	St. Louis Airport Site
SSL	Soil Screening Levels
SW	solid waste
SWMU	solid waste management unit
TCE	trichloroethene
UCL95	Upper 95 percent confidence level
UCL ₉₅	upper 95 percent confidence levels
USCS	Unified Soil Classification System
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
VSI	Visual Site Inspection
°C	degrees Celsius
μg/kg	microgram per kilogram
μs/cm	unit of conductivity

1.0 Introduction

This document represents the Phase 2 Environmental Site Assessment (ESA) Workplan Addendum for additional investigation tasks that will be completed at The Boeing Company's Fabrication Operations Facility in St. Louis, Missouri (Facility). This Phase 2 ESA Workplan Addendum supplements the previous Phase 2 ESA Work Plan performed by ESE for Boeing in July 2000.

1.1 Purpose

The Phase 2 ESA Work Plan Addendum presents the supplemental planned approach for evaluating environmental conditions at the Facility. This document and the previously prepared support plans describe the proposed technical scope of work and administrative/implementation approach for completion of the Phase 2 ESA investigation and reporting activities. Upon review and formal approval by MDNR, this Phase 2 Workplan Addendum will serve as the planning document for the supplemental field investigation at the Facility. The field investigation component of the Workplan Addendum will be utilized in conjunction with two associated support plans including a Quality Assurance Project Plan (QAPP) and a Health and Safety Plan (HASP) which were previously prepared by Golder Associates.

1.2 Workplan Addendum Organization

This Workplan Addendum is divided into eight sections of text. A brief description of each section is presented below.

Section 1.0, **Introduction**, describes the purpose and content of this Workplan Addendum.

Section 2.0, **Project Management**, references the various management and administrative issues associated with the project.

Section 3.0, **Supplemental Investigation Approach**, summarizes the Phase 2 ESA findings to date and presents the planned sample collection/analysis approach for the supplemental field activities at the Facility.

Section 4.0, **Sampling and Analysis Procedures**, describes the procedures to be implemented for all field sampling and laboratory analysis activities.

Section 5.0, **Evaluation of Investigation Results**, describes the development, tracking, evaluation, and presentation of investigative data.

Section 6.0, **Quality Assurance/Quality Control**, references the quality assurance and quality control measures to be implemented for all data collection activities.

Section 7.0, **Health and Safety**, references the health and safety procedures to be utilized for all field investigation activities.

Section 8.0, **References**, provides a list of references that were used in the development of this Workplan Addendum document.

2.0 Project Management

The overall project management approach for the Boeing Phase 2 ESA is detailed in the previous Phase 2 ESA Workplan prepared by Golder Associates in May 2000. Project management modifications are summarized below.

2.1 Schedule

Based on the expedited timeframes necessitated by the potential property transaction, the supplemental field investigation and drilling tasks described in this Workplan Addendum are scheduled to begin on Monday, September 18, 2000. Duration of MDNR review processes, which control the start date of mobilization and field activities, has been estimated based upon conversations between MDNR and Boeing personnel.

2.2 Project Organization and Personnel

Boeing has contracted the environmental consulting firm of Environmental Science & Engineering, Inc. (ESE) to support Boeing in completing this Phase 2 ESA project. An organizational structure for the project has been developed to promote technical excellence, promote quality data collection and deliverables, enable a free flow of communications among project team members, and ensure adherence to schedule.

The efforts to be conducted during for the Phase 2 ESA have been divided into several different tasks to facilitate the most efficient use of qualified technical resources and ensure adequate oversight. All task managers report directly to the ESE Project Manager who in turn reports to the Boeing Project Manager. Subcontractor activities are under the direct supervision and control of the ESE Project Manager and Field Implementation Manager.

Supervisory personnel and their assigned responsibilities are described below:

Boeing Project Manager

Mr. Bryan Kury, Manager of Environmental and Hazardous Material Services, will serve as the Boeing Project Manager. He is responsible for implementing the project on behalf of Boeing and has the authority to commit the resources necessary to meet project objectives and requirements. The Boeing Project Manager's primary function is to ensure that legal, financial, technical, and scheduling objectives are achieved successfully. The Boeing Project Manager will serve as the primary interface with the MDNR Project Manager, Mr. Richard Nussbaum, and will provide the primary point of contact and control for matters concerning the project.

The Boeing Project Manager's responsibilities include:

- Coordination of Boeing review for all submittals and deliverables;
- Final approval of all submittals and deliverables;
- Coordination with ESE and regulatory agency personnel;
- Coordination with the ESE Project Manager to correct any problems which may arise during the course of the Phase 2 ESA; and
- Assuring compliance with all legal and Boeing contractual requirements.

As a Senior Manager for Boeing, Mr. Kury has considerable experience negotiating permits and overseeing RCRA Corrective Action, permitting, and closure activities on behalf of the Facility.

ESE Project Manager

Mr. Doug Marian will serve as the ESE Project Manager for the Boeing Phase 2 ESA program. Mr. Marian maintains overall responsibility for ensuring that the project meets MDNR, USEPA, and Boeing objectives and quality standards. Reporting directly to the Boeing Project Manager, his primary functions include strategy development, technical quality control, ensuring appropriate Boeing communications with MDNR, project oversight, and daily management of all Phase 2 ESA activities. All ESE task managers and subcontractors report to Mr. Marian. Specific responsibilities of the ESE Project Manager include:

- Preparation and oversight of technical and administrative workplans, including approval of sampling/monitoring site locations, analytical parameters, field procedures, schedules, and manpower allocations;
- Preparation of quarterly progress reports, including schedule updates;
- Management of all funds for labor and materials procurement;
- Direct communication with the Boeing Project Manager;
- Technical review of all project deliverables;
- Assurance of cost-effective implementation for all project work;
- Verification of compliance with all project-related Boeing and legal requirements applicable to the ESE project team;
- Maintaining site team integrity throughout the period of performance; and
- Coordination of site teams and support personnel to ensure consistency of performance and adherence to project schedule.

As a Senior Engineer with ESE, Mr. Marian has 15 years of experience in the hazardous waste field including participation in 20 RCRA/CERCLA projects nationwide. In addition to the Boeing project, he serves as Project Manager/Engineer on three other site investigation projects currently being conducted by ESE.

Project Quality Assurance Manager

Ms. Lana Smith is the designated ESE Environmental Quality Assurance/Data Validation Manager for the Boeing Phase 2 ESA. As the Project Quality Assurance Manager, Ms. Smith's primary responsibilities are to monitor field data collection procedures and to ensure appropriate analysis/review by qualified technical staff. Specific responsibilities of the Consultant Project Quality Assurance Manager include:

- Ensuring that QA procedures, as identified in the QAPP, are followed;
- Verifying that adequate QA documentation is provided for analytical, field programs, and engineering calculations;
- Determining that all QA problems are resolved in an expeditious manner and brought to the attention of the ESE Project Manager;
- Coordinating and ensuring that all applicable QA procedures are followed by any subcontractors; and
- Ensuring that observations, conclusions, and recommendations have been reviewed by qualified and appropriate technical personnel.

With more than 13 years of experience in the environmental field, Ms. Smith has specialized expertise in the development of QAPPs and data validation. Currently, she is providing similar services for a hazardous waste site investigation study for a coal gasification facility in USEPA Region 5.

Field Implementation Manager

The Field Implementation Manager, Mr. Dennis Brinkley, P.E., R.G., is responsible for the technical work performed during the field investigation component of the Phase 2 ESA. His duties include:

- Development/Implementation of field-related work plans, assurance of schedule compliance, and adherence to management-developed study requirements;
- Coordination of field activities between ESE personnel and subcontractors;
- Review of all field sampling data for compliance with the QAPP and for technical accuracy;
- Review and interpretation of all geologic data;
- Confirming that adequate field quality control documentation is provided;
- Ensuring that all field problems are resolved in an expeditious manner and brought to the attention of the ESE Project Manager; and
- Ensuring compliance with the HASP and other applicable safety precautions.

A geological engineer with 13 years of experience in the environmental field, Mr. Brinkley is extremely familiar with hydrogeologic conditions in the greater St. Louis area. Currently, he serves as Project Manager for two ongoing hazardous waste site investigations in USEPA Region 7.

Phase 2 ESA Report Manager

The Phase 2 ESA Report Manager, Mr. Doug Marian, will be responsible for evaluation and presentation of data, as well as production of the draft and final Phase 2 ESA reports. His specific duties include:

- Review and interpretation of all validated analytical data;
- Summary of contaminant data in both tabular and graphic forms; and
- Production of draft and final Phase 2 ESA Reports.

Risk Assessment Manager

The Risk Assessment Manager, Mr. Jim Kountzman, will be responsible for identification of potential exposure pathways, analysis of data comparison to risk-based standards, and the completion of risk assessments, as necessary. His specific duties include:

- Development of site-specific investigation thresholds, as necessary, against which the Phase 2 ESA data will be compared;
- Identification of complete exposure pathways which will be addressed, as necessary, during future risk assessment activities; and
- Completion of human health risk assessments as determined to be necessary by the results of the Phase 2 ESA findings.

A senior toxicologist with more than 19 years of professional experience, Mr. Kountzman has performed both human health and ecological risk assessments at RCRA Corrective Action, CERCLA, and state voluntary program sites within USEPA Regions 7, 5, and 4. As such, he is quite familiar with the specific policy and guidance required in each Region.

Health and Safety Manager

Ms. Lana Smith is the designated ESE Health and Safety Manager for the Boeing Phase 2 ESA. As the Health and Safety Manager, Ms. Smith's primary responsibilities are to identify health and safety issues of concern prior to field mobilization, assist the Project Manager in preparing safety plans for site activities, and train project personnel in appropriate safety practices.

Her specific duties, per the Boeing Site-Specific Health and Safety Plan (HASP) are listed below:

- Maintaining and implementing the site-specific HASP;
- Approving any changes in the HASP due to modifications of procedures or newly-proposed site activities related to the Phase 2 ESA Workplan;
- Providing health and safety issues coordination between the ESE Project Manager, the Boeing Project Manager, and other contractors on the project;
- Resolving outstanding safety issues which arise during the conduct of site work;
- Assigning health and safety-related duties to qualified field team individuals;

- Ensuring that personnel maintain acceptable current medical examinations prior to beginning on-site work;
- Ensuring the acceptability of health and safety training; and
- Issuing authorization, in cooperation with the project manager, to proceed with work after a **STOP WORK** action has been issued on-site.

Ms. Smith currently serves as the ESE Regional Health and Safety Representative (RHSR) and, as such, is trained and qualified in the development/implementation of HASPs at hazardous waste sites.

Supplemental Technical Staff

Additionally required technical support will be drawn from ESE's pool of local resources.

Supplemental technical staff will be utilized to gather/analyze data and to prepare various task reports/supporting materials. All of the designated technical team members are experienced professionals who possess the degree of specialization and technical competence required to effectively and efficiently perform the required work. Specific individual responsibilities will include:

- Provision of day-to-day technical assistance in specific areas of expertise;
- Coordination and management of field personnel including subcontractors;
- Application of quality control measures to technical data provided by the field staff, including field measurement data;
- Maintaining field logs and transferring data for permanent storage; and
- Participating in preparation of the final report.

Subcontractors

With the approval of Boeing's Project Manager, ESE will utilize TEG Mid-America, Inc. (St. Louis, Missouri) for on-site laboratory services and Severn Trent Laboratories (Earth City, Missouri) to complete the required off-site laboratory analyses. Both laboratories possess the capability to perform the required analytical methods and the associated QA/QC back-up data.

ESE will utilize the services of Roberts Environmental Drilling, Inc. (Columbia, IL) to complete the required soil boring, monitoring well, and temporary piezometer installation efforts. Roberts Drilling retains experienced, licensed personnel who maintain the required OSHA health and safety training certifications. ESE will provide overall project management, coordination, and quality control of subcontractor activities in accordance with the Phase 2 ESA Workplan objectives.

3.0 Supplemental Investigation Approach

This section of the Phase 2 ESA Workplan Addendum describes the approach that will be utilized to conduct supplemental investigations at the Facility (Phase 2B). Results from the initial Phase 2A investigation activities are summarized at the beginning of each sub-section to establish the basis for the Phase 2B investigation efforts. Recommended approaches for sampling and analysis are then provided along with supporting rationale to characterize the nature and extent of any potential hazardous constituent/ waste releases to soil or groundwater at the Facility.

3.1 Overview of Sampling Approach

A biased sampling approach will be used to locate the Phase 2B ESA sampling locations. The approximate locations, number of samples, and analyses have been determined using the following criteria:

- Phase 2A soil boring and analytical results acquired in July-August, 2000;
- soil boring and analytical results from previous investigations at the Facility;
- facility/property layout;
- hazardous constituents or wastes managed;
- field conditions (e.g. staining, cracks, obstructions); and
- historical operations or procedures performed at the specific building/site.

A discussion of the specific investigative approach for each area is provided in the following subsections. The proposed sampling locations are approximate and subject to slight revision at the time of sampling, based on field observations and encountered conditions. Table 3-1 presents a summary of the supplemental investigation parameters for each area including: number of borings, number of groundwater monitoring points, number of samples, target constituents, analytical methods, sample selection criteria, sample collection method, and projected minimum boring depth.

Subsurface soil and groundwater sampling methods will be conducted to further evaluate environmental conditions at the Facility. In the event that the selected sampling method proves unsuitable at a specific location due to access restrictions, subsurface restrictions, or unsuitable soils, an alternate sampling method may be employed. Any alternate sampling methods must be capable of collecting representative samples in a manner which is consistent with the objectives of the Phase 2 ESA. Due to the presence of buried utilities in the area, actual sampling locations will be determined through discussions with Boeing facilities personnel and confirmed in the field prior to sampling.

Approximate locations for the proposed soil borings, monitoring wells, and temporary piezometers are displayed in Figure 3-1.

3.2 Supplemental Groundwater Investigation Tasks

Phase 2A ESA analytical results for the groundwater samples collected from specific portions of the Facility indicate the presence of constituent impacts to the shallow water-bearing unit. VOCs were consistently detected in groundwater samples beneath/adjacent to most portions of Building 27 and the only sample collected beneath Building 220. Detected VOCs included TCE and several associated degradation products (e.g. 1,2-DCE, vinyl chloride, 1,1-DCE, and 1,1-DCA). As a result, various Phase 2B ESA field investigation tasks are recommended at these locations to further evaluate the nature and extent of any potentially impacted groundwater in the shallow and deep water-bearing units.

3.2.1 Supplemental Groundwater Evaluation at Building 27

Phase 2A ESA analytical results for the groundwater samples collected from the Facility indicate the presence of constituent impacts at an area beneath and surrounding Building 27. VOCs were consistently detected to the west of Building 27 (hydraulically upgradient), beneath most portions of Building 27, and to the east of Building 27 (hydraulically downgradient). Detected VOCs included TCE and several associated degradation products (e.g. 1,2-DCE, vinyl chloride, 1,1-DCE, and 1,1-DCA). Various Phase 2B ESA field investigation tasks are recommended to further evaluate the nature and extent of impacted groundwater in the vicinity of Building 27.

3.2.1.1 Investigation of Downgradient Locations

Several VOC and metal (primarily chromium) constituents of concern exceed groundwater ITLs to the east (downgradient) of Building 27. As a result, supplemental Phase 2B investigation tasks are recommended to evaluate groundwater conditions in this area. These supplemental tasks are summarized below.

Evaluation of VOC Impacts to the East of Building 27

Additional Geoprobe borings (B27E3, B27E4, etc.) will be located to the east of Building 27 to help delineate the horizontal/vertical extent of VOC impacts to groundwater. Boeing's objective is to establish "clean" groundwater monitoring points (1 shallow, 1 deep) that will delineate the extent of any downgradient impacts. These locations will also serve to further delineate the horizontal and vertical extent of VOC impacts to soil to the east of Building 27.

Soil samples will be collected at selected intervals from each of the soil borings. Based on an anticipated groundwater elevation of 8-10 ft bls, each soil boring will be completed to an approximate depth of 20 ft bls.

With the objective of identifying "clean" soil and groundwater verification samples, Boeing will collect and submit representative soil samples from different depths and one groundwater sample (if encountered) for on-site lab analysis of VOCs. Samples will be screened for on-site analysis utilizing appropriate field instrumentation including a photoionization detector (PID). The ESE field geologist will also retain authority to analyze samples on the basis of visual/olfactory means.

If detectable PID readings are encountered for any of these soil borings, Boeing anticipates collecting a sample from the interval containing the highest PID reading and submitting it for on-site analysis. Furthermore, if evidence of TCE/VOC impacts is encountered at a boring location, an additional set of borings will be advanced at a location which is approximately 50 ft further east of Building 27 (hydraulically downgradient). This "step-out" process will be utilized to accurately delineate the horizontal extent of any VOC impacts and optimize placement of subsequent monitoring wells. If unexpected field conditions are encountered, the ESE field geologist and Boeing will discuss any recommended changes in sampling approach.

A nested set of groundwater monitoring wells (MW8A-S and MW8A-D) will be completed immediately adjacent to the "clean" Geoprobe boring. Following development and purging of these wells, groundwater samples will be collected from each of the wells and tested for oxidation/reduction potential and dissolved oxygen using appropriate field screening instrumentation. This field data will be useful in assessing the biodegradability of VOCs in groundwater at this area.

Groundwater samples will subsequently be collected from both of these monitoring wells as part of the Phase 2B groundwater monitoring program. This monitoring program is described in Section 3.2.3.

Evaluation of Chromium Impacts to the East of Building 27

Additional Geoprobe borings (B27E6, B27E7, etc. [consecutively numbered following completion of the VOC evaluation previously described]) will be located to the east of Building 27 to help delineate the horizontal/vertical extent of chromium impacts to groundwater. Boeing's objective is to establish "clean" groundwater monitoring points (1 shallow, 1 deep) that will delineate the extent of any downgradient impacts. These locations will also serve to further delineate the horizontal and vertical extent of any chromium impacts to soil to the east of Building 27.

Soil samples will be collected at selected intervals from each of the soil borings. Based on an anticipated groundwater elevation of 8-10 ft bls, each soil boring will be completed to an approximate depth of approximately 20 ft bls.

With the objective of identifying "clean" soil and groundwater verification samples, Boeing will collect and submit representative soil samples from 2 different depth intervals (approximately 4-8 ft bls and 16-20 ft bls) for on-site XRF screening or lab analysis. The ESE field geologist will retain the authority to select samples on the basis of visual discoloration.

If elevated XRF readings (e.g. >85 mg/kg chromium) or detectable PID readings are encountered for any of these soil borings, Boeing anticipates collecting a sample from the interval containing the highest reading and submitting it for on-site VOC analysis. Furthermore, if evidence of elevated chromium or TCE/VOC impacts is encountered at a boring location, an additional set of borings will be advanced at a location which is approximately 50 ft further east of Building 27 (hydraulically downgradient). This "step-out" process will be utilized to accurately delineate the horizontal extent of any metals and/or VOC impacts, and optimize placement of subsequent monitoring wells. If unexpected field conditions are encountered, the ESE field geologist and Boeing will discuss any recommended changes in sampling approach.

A nested set of groundwater monitoring wells (MW5A-S and MW5A-D) will be completed immediately adjacent to the "clean" Geoprobe boring. Following development and purging of these wells, groundwater samples will be collected from each of the wells and tested for oxidation/reduction potential and dissolved oxygen using appropriate field screening instrumentation. This field data will be useful in assessing the biodegradability of VOCs in groundwater at this area.

Groundwater samples will subsequently be collected from both of these monitoring wells as part of the Phase 2B groundwater monitoring program. This monitoring program is described in Section 3.2.3.

Evaluation of Deep Groundwater Unit along Eastern Property Line

One deep groundwater monitoring well (MW6-D) will be completed immediately adjacent to existing monitoring well MW6 along the eastern property boundary to evaluate any potential impacts to groundwater in the deep water-bearing unit. Following development and purging of this well, groundwater samples will be collected from this well and tested for oxidation/reduction potential and dissolved oxygen using appropriate field screening instrumentation. This field data will be useful in assessing the biodegradability of VOCs in groundwater at this area.

Groundwater samples will subsequently be collected from this monitoring well as part of the Phase 2B groundwater monitoring program. This monitoring program is described in Section 3.2.3.

3.2.1.2 Investigation of Recycling Area and Hazardous Waste Area

Several VOCs and metal constituents of concern exceed groundwater ITLs within the area to the west of Building 27 (Recycling and Hazardous Waste Areas). As a result, supplemental Phase 2B investigation tasks are recommended to evaluate groundwater conditions in this area. These supplemental tasks are summarized below.

Approximately 8 additional soil borings (RC4, RC5, RC6, RC7, RC8; B27W1, B27W2, B27W3) will be located within the potential source area west of Building 27 to help delineate the horizontal/vertical extent of VOC impacts to groundwater and soil in this area. These soil borings will also facilitate the determination of various hydrogeological parameters in the shallow water-bearing unit. Due to the areal constraints between Buildings 28 and 39, and the fact that soil/groundwater impacts have already been characterized at B28N1 and B28E1, no additional soil borings will be completed in the immediate vicinity of Building 28.

Soil samples will be collected continuously from each of the soil borings in this area. Based on an anticipated groundwater elevation of 5-10 ft bls, these soil borings will each be completed to an approximate depth of 16 ft bls.

With the objective of delineating the horizontal and vertical extent of any soil and/or groundwater impacts in this area, representative soil samples from different depths and one groundwater sample (if encountered) will be collected/screened for on-site lab analysis. If detectable PID readings are encountered for any of the borings, Boeing anticipates collecting a sample from the interval containing the highest PID reading and submitting it for on-site analysis of VOCs. An additional soil sample will be collected from B27W3 to verify the absence of any pesticide constituents. The ESE field geologist will also retain authority to analyze samples on the basis of visual/olfactory means.

Additional borings may be advanced in this area depending on the detected VOC concentrations. This process will be utilized to reasonably delineate the horizontal extent of any VOC impacts and optimize placement of any subsequent sampling locations. If unexpected field conditions are encountered, the ESE field geologist and Boeing will discuss any recommended changes in sampling approach.

Specialized Geoprobe sampling equipment will be used to evaluate soil and groundwater conditions beneath the shallow water-bearing unit at this area. A Dual Tube sampler will be used to eliminate potential cross-contamination between the water-bearing units. Two sets of probe rods are used to collect continuous soil samples as follows:

- 1) The outer set of 2.125-inch OD rods is initially driven into the ground as a protective casing. These rods provide a sealed hole that eliminates the potential of any side slough and enables the collection of soil samples across a perched water table.
- 2) The second smaller set of 1.0-inch OD rods are then placed inside of the outer casing. The smaller rods hold a sample liner in place as the outer casing is driven one sampling interval.
- 3) The smaller rods are then retracted to collect the soil sample from the filled liner.

Three of the 8 soil borings from this area (RC6, RC8, and B27W3) will be completed to an approximate depth of 30 ft bls to evaluate conditions beneath the shallow water-bearing unit. The Dual Tube system will facilitate the safe collection of groundwater samples immediately below the Silt Unit (30-35 ft bls) at this area to verify that the unit serves as an aquitard to limit vertical migration of any VOC constituents. Groundwater samples will be collected from each location and tested for oxidation/reduction potential and dissolved oxygen using appropriate field screening instrumentation. This field data will be useful in assessing the biodegradability of VOCs in groundwater at this area.

To prevent cross-contamination during abandonment, each Dual Tube boring will be grouted from the bottom up while retracting the outer casing.

3.2.1.3 Investigation of Cross-Gradient Locations

Several VOCs and metal constituents of concern exceed groundwater ITLs along the northwest corner of Building 27. In addition, the corridor to the immediate north of Building 27 is expected to serve as the future north-south property boundary between Boeing and the future operator of the Facility. As a result, supplemental Phase 2B investigation tasks are recommended to evaluate groundwater conditions in this area. These supplemental tasks are summarized below.

Evaluation of VOC Impacts to the Northwest of Building 27

Additional Geoprobe borings (B27NW1, etc.) will be located to the northwest of Building 27 to help delineate the horizontal/vertical extent of any potential VOC impacts to groundwater. Boeing's objective is to establish "clean" groundwater monitoring points (1 shallow and 1 deep) that will delineate the extent of any potential impacts. These locations will also serve to delineate the horizontal and vertical extent of any potential VOC impacts to soil in this area.

Soil samples will be collected at selected intervals from each of the soil borings. Based on an anticipated groundwater elevation of 8-10 ft bls, each soil boring will be completed to an approximate depth of 20 ft bls.

With the objective of identifying "clean" soil and groundwater verification samples, Boeing will collect representative soil samples from different depths and one groundwater sample (if encountered) for on-site lab analysis of VOCs. Samples will be screened for on-site analysis utilizing appropriate field instrumentation including a PID. The ESE field geologist will also retain authority to analyze samples on the basis of visual/olfactory means.

If detectable PID readings are encountered for any of these soil borings, Boeing anticipates collecting a sample from the interval containing the highest PID reading and submitting it for on-site analysis. Furthermore, if evidence of VOC impacts is encountered at a boring location, an additional set of borings may be advanced at a location that is further east (hydraulically downgradient) of the initial location, depending on the extent of surface/subsurface obstructions. This "step-out" process will be used where feasible to delineate the horizontal extent of any VOC impacts and optimize placement of subsequent monitoring wells. If unexpected field conditions are encountered, the ESE field geologist and Boeing will discuss any recommended changes in sampling approach.

A nested set of groundwater monitoring wells (MW9-S and MW9-D) will be completed immediately adjacent to the "clean" Geoprobe boring. Following development and purging of these wells, groundwater samples will be collected from each monitoring well as part of the Phase 2B groundwater monitoring program. This monitoring program is described in Section 3.2.3.

3.2.2 Supplemental Groundwater Evaluation at Building 220

Phase 2A ESA analytical results for the groundwater sample from B220I1 indicate the presence of VOC impacts beneath Building 220. Detected VOCs included TCE and several associated degradation products (e.g. 1,2-DCE and 1,1-DCE). TCE exceeds the groundwater ITL at this location. As a result, supplemental Phase 2B investigation tasks are recommended to further evaluate the nature and extent of impacted groundwater in the vicinity of Building 220. These supplemental tasks are summarized below.

Evaluation of VOC Impacts to the East of Building 220

A nested set of groundwater monitoring wells (MW10-S and MW10-D) will be completed to the east of Building 220 to help delineate the horizontal/vertical extent of VOC impacts to groundwater. Boeing's objective is to establish "clean" groundwater monitoring points (1 shallow, 1 deep) that will delineate the extent of any downgradient impacts. These locations will also serve to evaluate any potential VOC impacts to soil to the east of Building 220.

Boeing will collect representative soil samples from different depths for off-site lab analysis of VOCs. Samples will be screened for off-site analysis utilizing appropriate field instrumentation including a PID. If detectable PID readings are encountered for either of these soil borings, Boeing anticipates

collecting a sample from the interval containing the highest PID reading and submitting it for off-site analysis. The ESE field geologist will also retain authority to analyze samples on the basis of visual/olfactory means.

The nested set of groundwater monitoring wells (MW10-S and MW10-D) will be completed to the west of the fenceline adjacent to Building 220. Following development and purging of these wells, groundwater samples will be collected from each of the wells and tested for oxidation/reduction potential and dissolved oxygen using appropriate field screening instrumentation. This field data will be useful in assessing the biodegradability of VOCs in groundwater at this area.

Groundwater samples will subsequently be collected from each monitoring well as part of the Phase 2B groundwater monitoring program. This monitoring program is described in Section 3.2.3.

3.2.3 Groundwater Monitoring Tasks

Phase 2B groundwater monitoring tasks will be completed to delineate the horizontal/vertical extent of any VOC impacts to groundwater and document groundwater elevations across the Facility. Groundwater samples will be collected from each of the 9 monitoring wells that are installed during the Phase 2B activities. These samples will be evaluated for selected field criteria (temperature, pH, and conductivity) and then submitted for off-site analysis of VOCs. Seven of these groundwater samples (MW8A-S, MW8A-D, MW5A-S, MW5A-D, MW6-D, MW10-S, MW10-D) will also be submitted for off-site analysis of selected biodegradation parameters (total organic carbon [TOC], dissolved organic carbon, nitrate, nitrite, nitrate/nitrite as N, chloride, total iron, ferrous iron, and sulfate).

Groundwater elevation and field parameter measurements will be performed for all of the monitoring wells and existing temporary piezometers installed during the Phase 2A or 2B activities.

3.3 Supplemental Soil Investigation Tasks

Phase 2A ESA analytical results for samples collected from the Facility indicate the presence of isolated constituent impacts to subsurface soils. Elevated VOCs were detected in soil samples beneath/adjacent to several portions of Building 27 and the only sampling location beneath Building 220. Detected VOCs included TCE and several associated degradation products (e.g. 1,2-DCE, vinyl chloride, 1,1-DCE, and 1,1-DCA). Elevated diesel petroleum hydrocarbons were detected in the soil sample to the east of Building 27 and the groundwater sample to the immediate north of Building 220. In addition, Boeing has expressed an interest in the collection of soil samples adjacent to the railroad tracks along the north side of Banshee Road for analysis of herbicide and pesticide constituents. As a result, various Phase 2B ESA field investigation tasks are recommended at these locations to further evaluate the nature and extent of any potentially impacted soils at these specific areas of the Facility.

3.3.1 Supplemental Soil Evaluation at Building 27

Phase 2A ESA analytical results for soil samples collected from the Facility indicate the presence of constituent impacts to soils at isolated areas beneath and surrounding Building 27. Elevated VOCs were detected to the west of Building 27 (hydraulically upgradient), beneath the northwest corner of Building 27 (B27I1), and to the east of Building 27 (hydraulically downgradient). TCE, vinyl chloride, and chromium exceed the soil ITLs at isolated locations in the vicinity of Building 27. The diesel petroleum hydrocarbon level in the soil sample to the east of Building 27 (B27E2) also exceeds the soil ITL. As a result, various Phase 2B ESA field investigation tasks are recommended to further evaluate the nature and extent of impacted soil in the vicinity of Building 27.

With the objective of further delineating the horizontal extent of constituent impacts to subsurface soils at Building 27, Boeing will collect representative soil samples from different depths and one groundwater sample (if encountered) for on-site lab analysis of VOCs. The proposed soil sampling approach/locations for Building 27 are described in Section 3.2.1 due to the inter-related nature of the groundwater investigation tasks. Please review Section 3.2.1 for a detailed description of the soil investigation tasks at Building 27.

3.3.2 Supplemental Soil Evaluation at Building 220

Phase 2A ESA analytical results for samples collected from the Facility indicate the presence of constituent impacts to soils at isolated areas beneath and surrounding Building 220. Elevated VOCs were detected beneath Building 220 (B220I1). Detected VOCs included TCE and several associated degradation products (e.g. 1,2-DCE and 1,1-DCE). Elevated diesel petroleum hydrocarbons were also detected in the groundwater sample to the north of Building 220 (B220N1). As a result, various Phase 2B ESA field investigation tasks are recommended to further evaluate the nature and extent of impacted subsurface soils in the vicinity of Building 220.

Evaluation of VOC Impacts to the East of Building 220

The nested set of groundwater monitoring wells (MW10-S and MW10-D) located to the east of Building 220 will help to delineate the horizontal/vertical extent of VOC impacts to subsurface soils. Representative soil samples from different depths will be collected for on-site lab analysis of VOCs. The proposed soil sampling approach/locations for Building 220 are described in Section 3.2.2 due to the inter-related nature of the groundwater investigation tasks. Please review Section 3.2.2 for a detailed description of the soil investigation tasks at Building 220.

Evaluation of Diesel Petroleum Hydrocarbon Impacts to the North of Building 220

Additional Geoprobe borings (B220N2, B220N3, etc.) will be located to the north of Building 220 to help delineate the horizontal/vertical extent of petroleum hydrocarbon impacts to subsurface soils and verify that migration is not occurring onto the Boeing Facility from any off-site sources.

Soil samples will be collected at selected intervals from each of the soil borings. Based on an anticipated groundwater elevation of 6-8 ft bls, each soil boring will be completed to an approximate depth of 20 ft bls.

With the objective of identifying "clean" soil and groundwater verification samples, Boeing will collect representative soil samples from different depths and one groundwater sample (if encountered) for on-site lab analysis of petroleum hydrocarbons. Samples will be screened for on-site analysis utilizing appropriate field instrumentation including a PID. The ESE field geologist will also retain authority to analyze samples on the basis of visual/olfactory means.

If detectable PID readings are encountered for any of these soil borings, Boeing anticipates collecting a sample from the interval containing the highest PID reading and submitting it for on-site analysis. Furthermore, if evidence of petroleum hydrocarbon impacts is encountered at a boring location, an additional boring will be advanced at a location that is further away (hydraulically downgradient) from Building 220. This "step-out" process will be utilized to accurately delineate the horizontal extent of any petroleum hydrocarbon impacts and determine whether migration is occurring onto the Boeing Facility from any off-site sources. If unexpected field conditions are encountered, the ESE field geologist and Boeing will discuss any recommended changes in sampling approach.

One soil boring from this area will be selected during the field investigation for completion as a temporary piezometer. Following development and purging of the temporary piezometer, groundwater samples will be collected for evaluation of selected field criteria (temperature, pH, and conductivity) and then submitted for off-site analysis of VOCs.

3.3.3 Soil Evaluation of Railroad Corridor

Boeing has expressed an interest in the collection of soil samples adjacent to the railroad tracks along the north side of Banshee Road for analysis of herbicide and pesticide constituents. As a result, Phase 2B ESA field investigation tasks will be conducted to evaluate the nature and extent of any potentially impacted soils along the railroad corridor.

Four Geoprobe borings (RR1, RR2, RR3, and RR4) will be located at equally spaced intervals on the north side of the railroad tracks to characterize the extent of any potential constituent impacts to subsurface soils. Representative soil samples will be collected from different depths and submitted for off-site lab analysis of herbicides. An additional soil sample will be collected from RR2 to verify the absence of any pesticide constituents.

Soil samples will be collected at selected intervals from each of the soil borings. Each soil boring will be completed to an approximate depth of 4 ft bls.

Boeing will collect and submit representative soil samples from different depths for off-site lab analysis of herbicides and pesticides. The ESE field geologist will retain authority to analyze samples on the basis of visual/olfactory means. If unexpected field conditions are encountered, the ESE field geologist and Boeing will discuss any recommended changes in sampling approach.

Table 3-1. Summary of Investigation Parameters for Phase 2B Activities

Building/Area ID	No. of Borings	Approx. No. of Soil Samples	No. of New Groundwater Monitoring Wells	No. of Groundwater Samples (incl. temporary piezometers)	Target Analytical Constituents	SW846 Method	Sample Selection Criteria	Projected Sampling Intervals	Investigation Method	Projected Boring Depth*	Comments
East of Building 27 (Evaluation of VOC Impacts)	3	3	2 (1 shallow MW and 1 deep MW)	3	VOCs RCRA Metals (8)	8260 6010, 7060 7471, 7740	Highest PID &/or Visual Determination	Variable (see Section 3.2 for specific intervals)	Geoprobe and HSA	20 ft for soil borings & shallow MW; 60 ft for deep MW	50 ft horizontal step-outs if TCE/VOC impacts are evident.
East of Building 27 (Evaluation of Chromium Impacts)	3	3	2 (1 shallow MW and 1 deep MW)	3	VOCs RCRA Metals (8)	8260 6010, 7060 7471, 7740	Metals - XRF/Staining VOCs - Highest PID/Greatest Depth	Variable (see Section 3.2 for specific intervals)	Geoprobe and HSA	20 ft for soil borings & shallow MW; 60 ft for deep MW	50 ft horizontal step-outs if TCE/VOC impacts are evident.
Eastern Property Line	1	0	1 (1 deep MW)	1	VOCs RCRA Metals (8)	8260 6010, 7060 7471, 7740	Highest PID &/or Visual Determination	Variable (see Section 3.2 for specific intervals)	HSA	60 ft for deep MW	
Recycling and Hazardous Waste Areas	8	8	0	11	VOCs RCRA Metals (8) Pesticides	8260 6010, 7060 7471, 7740 8081	Highest PID &/or Visual Determination	Variable (see Section 3.2 for specific intervals)	Geoprobe	16 ft for shallow soil borings; 30 ft for Dual Tube borings	Horizontal step-outs if TCE/VOC impacts are evident. Only B27W3 will be submitted for pesticide analysis.
Northwest of Building 27	3	3	2 (1 shallow MW and 1 deep MW)	3	VOCs RCRA Metals (8)	8260 6010, 7060 7471, 7740	Highest PID &/or Visual Determination	Variable (see Section 3.2 for specific intervals)	Geoprobe and HSA	20 ft for soil borings & shallow MW; 60 ft for deep MW	Horizontal step-outs if TCE/VOC impacts are evident.
East of Building 220	2	2	2 (1 shallow MW and 1 deep MW)	2	VOCs RCRA Metals (8)	8260 6010, 7060 7471, 7740	Highest PID &/or Visual Determination	Variable (see Section 3.2 for specific intervals)	Geoprobe and HSA	20 ft for shallow MW; 60 ft for deep MW	
North of Building 220	2	2	0	2	TPH VOCs RCRA Metals (8)	OA1 & OA2 8260 6010, 7060 7471, 7740	Highest PID &/or Visual Determination	Variable (see Section 3.2 for specific intervals)	Geoprobe	20 ft	Horizontal step-outs if TPH/VOC impacts are evident.
Railroad Corridor	4	4	0	0	Herbicides Pesticides	8151 8081	Greatest Depth &/or Visual Determination	3-4 ft bls	Geoprobe	4 ft	All 4 samples will be submitted for herbicide analysis. Only RR2 will be analyzed for pesticides.
Total	26	25	9	25							

* Vertical delineation depth subject to field modifications.

4.0 Sampling and Analysis Procedures

This section describes the pertinent sample collection, monitoring well installation, and laboratory analysis procedures.

4.1 Direct Push Sampling Technology

4.1.1 Soil Sampling

Direct push/hydraulic soil probe (Geoprobe) subsurface sampling equipment will be utilized as the primary drilling methodology wherever site conditions permit its use. Geoprobe equipment will be mounted on a Bobcat or all-terrain vehicle (ATV) for subsurface investigations.

The hydraulic soil probe technology utilizes static and percussion forces to drive probing and sampling tools into the subsurface. The thin-walled soil sampling tube remains completely sealed as it is driven to the desired sampling depth by steel probing rods. An internal piston is then manually released allowing soil to enter the sampling tube, which is lined with a disposable polybutylate (acetate) liner. The sampling tube is then driven further to collect the soil from the desired depth interval. The sampling tube is withdrawn and the polybutylate-encased sample is removed from the sampling tube.

An aliquot of sample will be placed directly into the appropriate sample container from each sampling location. No compositing of samples shall be performed. The samples collected for VOC analysis will be filled to the top of the jar to minimize the amount of headspace in the jar which may result in the loss of volatile compounds from the sample. Samples collected for organic analysis shall be immediately placed into an iced sample cooler to prevent the loss of volatile compounds. Soil samples acquired for metals analysis will be collected by placing an aliquot of soil into an appropriate glass sample container. Sample container requirements are described in the previous Quality Assurance Project Plan (QAPP).

To prevent cross-contamination between samples, the sampler shall wear disposable latex gloves during the collection of the samples. The sampler shall don a new pair of disposable gloves before collecting each sample. Also, the sampler shall decontaminate the sampling devices prior to each use. Decontamination procedures are discussed in the QAPP.

Following completion, each boring will be grouted with granular bentonite to surface and hydrated. Each boring will be sealed at the surface with concrete or asphalt. Soil cuttings will be containerized in 55-gallon DOT-approved drums and stored for subsequent disposal as discussed in the QAPP. Any decontamination liquids generated will be disposed of at the IWTP.

4.1.2 Groundwater Sampling

Due to the limited availability of shallow groundwater for numerous locations across the Facility, temporary piezometers will be used to collect groundwater samples from the shallow soil borings. Each temporary piezometer will be constructed of 1-inch diameter PVC with flush-threaded joints. Five-foot screen sections will be utilized at the bottom of each installation. Each temporary piezometer will be installed to an approximate completion depth of 16-20 ft bls.

Prior to the collection of groundwater samples, each temporary piezometer will be purged using a disposable polyethylene mini-bailer. Due to the limited availability of groundwater in the shallow water-bearing unit, each temporary piezometer will be purged by removing one well casing volume of groundwater. Upon completion of the purging process, groundwater samples will be collected using either a dedicated bailer (VOCs or metals), or a peristaltic pump (metals only).

4.2 Monitoring Well Installation Procedures

Monitoring wells will be installed in accordance with standard hollow-stem auger (HSA) drilling methods using 8 1/4-inch (or 4 1/4-inch) internal diameter (ID) hollow-stem augers. Prior to drilling at the initial and all subsequent borings, ancillary rig equipment will be cleaned using a high pressure cleaner wash at the temporary on-site decon station to eliminate cross-contamination between successive drilling locations.

During the monitoring well installation process, soil samples will be collected at select locations/intervals for field screening, lithographic description, and potential chemical analysis. Soil samples will be collected using either a Lasky (5' x 4") core barrel or a split spoon (2' x 2") sampler. (One 60-ft Geoprobe boring may be completed prior to initiating the 2 HSA borings to fulfill the sample collection requirements and enhance the efficiency of the monitoring well installation process.) Each sampler will be opened and immediately scanned with a PID and/or FID to identify potential presence of VOCs. To maintain lithographic descriptive consistency, each soil sample will be described and classified in accordance with the Unified Soil Classification System (USCS).

Each monitoring well will be installed in accordance with the QAPP and the following general protocols:

- 1) Each monitoring well will be constructed of 2-inch diameter PVC with flush-threaded joints. Ten foot screen length sections (0.010-in slot) will be installed within each well.

- 2) The artificial sand pack will consist of chemically inert, rounded, silica sand and will be placed to a height of approximately two feet above the top of the screen.
- 3) A bentonite pellet seal three feet in thickness will be placed above the sand pack material.
- 4) The annular space above the bentonite pellet seal will be sealed with cement/bentonite grout.
- 5) Each monitoring well will be completed with a flush-mounted, water-tight protective casing.
- 6) Well construction details will be recorded on standard field forms.

Special installation procedures will be utilized for all deep monitoring wells that are installed to the bedrock surface to ensure that cross-contamination does not occur between the shallow and deep water-bearing units. Each deep well will be constructed by using 8-1/4" I.D. hollow stem augers to set a 10-inch casing at an approximate depth of 60 ft bls. The casing will be grouted from the bottom of the casing to ground level. After the grout has set, the boring will be advanced to total depth (approximately 70 ft bls) using 4-1/4" I.D. hollow stem augers.

After installation, all monitoring wells will be developed to ensure that particulate matter introduced into the formation from the drilling process is removed, and to ensure good hydraulic connection with the formation. Formation water and fines will be evacuated throughout the water column. A bailer or submersible pump will be moved up and down throughout the water column in the screened portion of the well to maximize water flow through the entire screened length. A surge block may be used to facilitate flow of water into the formation between withdrawal periods.

Development procedures will be continued until one of the following criteria is met:

- Removal of a minimum of three well casing volumes or until the well is dry; or
- Stabilized measurements of pH, temperature, and specific conductance are recorded (e.g. consecutive field readings within 10 percent of each other).

4.3 Field Screening and Sample Selection Procedures

Each soil sample will be screened in the field with a PID for total organic vapors (TOV) by the headspace method. This process will involve placing a portion of the soil sample into a resealable plastic bag and allowing time for volatilization, if any, to occur. The PID probe will then be inserted into the plastic bag. The highest PID reading measured for the initial 10-second period will be recorded on the boring log form in units of parts per million (ppm).

The PID will be calibrated at a minimum of once per day during the Phase 2 ESA field effort. Instrument calibration will be performed in accordance with the manufacturers' recommended procedures using either commercially available or laboratory-provided calibration standards. All calibration data will be recorded in the Field Equipment Calibration Logbook.

4.4 Sample Collection Procedures

Samples will be collected and selectively submitted for on- and off-site chemical analysis of VOCs, petroleum hydrocarbons, and metals according to the target constituent list identified for each area. The proposed analytical parameters were selected based on Phase 2A ESA results and knowledge of chemical usage at the Facility.

4.4.1 Soil Sampling

Soil samples will be collected from selected borings/intervals for lab analysis using the 4-ft Macro-Core Geoprobe sampler, Lasky core barrel, or split spoon sampler. In the event that coarse gravel fill material is encountered below the concrete and collection of sufficient soil volume is not possible, the borings will be advanced until finer-grained materials (e.g. sand, silt or clay) are encountered, and the sample then collected.

The results of the field screening (PID, visual observation) will be utilized in the selection of sample intervals. The sample with the highest TOV level will be submitted for chemical analysis. Visual observations by the field geologist will also be considered in the sample selection process. Refer to Sections 3.2 and 3.3 for site-specific screening criteria and anticipated sample depths.

4.4.2 Groundwater Sampling

Water level measurements will initially be performed using an electronic water level probe and measured to the nearest 1/100 foot. Data will be recorded in a field notebook and subsequently transferred to a standard monitoring form.

Prior to the collection of groundwater samples, each monitoring well will be purged using a downhole submersible pump or a disposable polyethylene bailer. Each monitoring well will be purged by removing a minimum of three well casing and sand pack volumes of groundwater and obtaining stabilized field parameter readings, or until dry. If groundwater is turbid after completion of the well purging process, the silt/clay particulates will be allowed to settle prior to initiating sample collection activities. A settling period of 1-6 hours is anticipated. Groundwater will subsequently be sampled/collected from the top of the water column. These measures will serve to minimize sample turbidity, thus enhancing the accuracy of the associated analytical results.

The following collection procedures will be observed when using a bailer to sample a groundwater monitoring well:

- Lower the bailer slowly to the interval from which the sample is to be collected.
- A determined effort will be taken to minimize disturbance of the water column when raising and lowering the bailer in order to prevent aeration of the water column.
- Sample bottles will be filled by allowing the water to flow out the valve in the bottom of the bailer and into and along the side of the sample bottle.

The following constraints will also be observed when using a bailer:

- Only bottom-filling HDPE bailers or bailers made of other inert materials will be used.
- Only unused, decontaminated, or dedicated bailer line will be used.
- A reel upon which the bailer line may be wound is helpful (but not required) in lowering and raising the bailer. It also reduces the chance of contamination.

4.4.3 DNAPL Sampling Considerations

Screening methods (interface probe and visual observation) will be utilized to evaluate the presence of potential DNAPL during the supplemental investigation (for samples collected from the Recycling and Hazardous Waste Storage Areas in particular). For any locations that indicate the presence of DNAPL, additional sample collection procedures will be implemented. If feasible, a dedicated bailer or submersible pump will be used to collect a DNAPL sample. The DNAPL sample will be submitted to an off-site laboratory for product fingerprint analysis.

4.5 Quality Assurance/Quality Control Samples

In accordance with the Phase 2 ESA QAPP, one duplicate soil sample will be collected and analyzed per twenty soil samples. The duplicate soil samples will be analyzed for the location-specific target list of VOCs, petroleum hydrocarbons, and/or metals. Similarly, one duplicate groundwater sample will be collected for the groundwater monitoring event and submitted for off-site lab analysis.

4.6 Sample Management, Preservation, and Chain-of-Custody Procedures

Upon collection, each sample will be managed according to the procedures described in this subsection. These procedures have been established in accordance with the QAPP. Appropriate

USEPA analytical methods, sample preservation techniques, sample volumes, and holding times are also presented in the QAPP.

4.6.1 Sample Containers

Samples will be collected into sample containers which have been pre-cleaned and assembled to USEPA's Protocol "B". The volume of sample collected and the type of container used will be determined by the suggested volumes described in SW-846 for the particular analysis. A summary of the bottle requirements and sample volumes is included in the QAPP.

4.6.2 Sample Management

Immediately upon collection, each sample will be properly labeled to prevent misidentification. The sample labels will include the sample number, the sample location, the sample depth, the date sampled, the time sampled, the analyses to be performed, and the sample collector's name. The sample labels will be affixed to the sample jar immediately upon collection. The sample labels will be made of waterproof material and filled out with waterproof ink.

After labeling, the samples will be placed into an appropriate shipping container. Samples collected for organic analysis will be placed into a shipping container with sufficient ice or ice packs to maintain an internal temperature of four-degrees (4°) Celsius during transport to the laboratory. The samples will be appropriately packaged in the shipping container to minimize the potential for damage during shipment. A completed chain-of-custody form will be placed in each shipping container to accompany the samples to the laboratory. The shipping containers will then be sealed with several strips of strapping tape.

The sample containers will be transported to the designated off-site laboratory. Samples will be transported so that no more than 24 hours elapse from the time of collection to the time that the laboratory receives the samples. The method of sample shipment will be noted on the chain-of-custody forms accompanying the samples. Strict chain-of-custody procedures will be maintained during sample handling.

4.6.3 Preservation

Samples for organic analyses will be preserved by placing each sample immediately into a cooler with sufficient ice or ice pack material to maintain a temperature of 4-degrees (4°) Celsius or less during transport to the laboratory. Sample preservation is not required for soil samples collected for metals analysis. Hydrochloric and nitric acid will be added to groundwater samples that are being analyzed for VOCs and metals, respectively. The required sample preservation methods for the specific constituents are included in the QAPP.

4.6.4 Chain-of-Custody

A chain-of-custody program will be followed to track the possession and handling of individual samples from time of collection through completion of laboratory analysis. Copies of the chain-of-custody record will be retained in the permanent file for proper documentation. The chain-of-custody forms shall include at a minimum:

- Sample number;
- Date and time of collection;
- Sample type (e.g., soil, groundwater, etc.);
- Parameters requested for analysis;
- Signature of person(s) involved in the chain of possession; and
- Inclusive dates of possession.

4.7 Analytical Methods

Samples will be submitted to qualified on-site and off-site laboratories for analysis. Sample analyses shall be selectively conducted for VOCs, petroleum hydrocarbons, and metals as previously described in Section 3. Lab quality assurance/quality control procedures will comply with the requirements of the QAPP.

4.8 Equipment Decontamination Procedures

All drilling and sampling equipment will be decontaminated prior to initial use at the Facility. Decontamination of Geoprobe equipment and other pieces of equipment will be performed at the drilling locations. Rinsewaters will be collected into a bucket or drum.

To prevent possible cross-contamination between samples, all down-hole drilling tools and sampling equipment will also be decontaminated between boring locations. Decontamination procedures for sampling equipment will consist of a wash of an Alconox solution, a potable/tap water rinse, followed by a distilled water rinse.

4.9 Waste Collection and Disposal Procedures

Waste materials derived from the field investigation, such as drill cuttings, decontamination rinsewaters, and personal protective equipment, will be collected in DOT-approved 55-gallon drums. The collected waste materials will be segregated into drums based on waste medium (water, soils, etc.). Each drum will be clearly labeled to indicate the type and approximate volume of contents, source, accumulation start date, and signature of the person completing the label.

The drums will be stored at an on-site location that will not disrupt Facility activities, yet provide a sufficient degree of security to deter any tampering with their contents. Equipment decontamination rinsewaters will be transferred to the influent of the IWTP where they will be treated to meet discharge standards in a similar manner with the chemical process influent. Drums with solid materials will remain on-site until proper disposal arrangements are completed by Boeing.

5.0 Evaluation of Investigation Results

Investigation results will be evaluated and subsequently presented in the Phase 2 ESA Report as described in the previously prepared Phase 2 ESA Workplan. In addition, the revised Phase 2 ESA Report will also address the following issues:

- New data and findings associated with the supplemental investigation (Phase 2B) of the Facility will be incorporated in the revised Phase 2 ESA Report;
- Existing data tables and figures will be updated to reflect the results of the supplemental investigation and groundwater monitoring program;
- New contaminant isoconcentration maps and/or other visual representations will be prepared to depict the horizontal and vertical extent of contamination; and
- Risk assessment calculations/conclusions will be developed, as needed, to incorporate all relevant data that are acquired from the Phase 2A and 2B investigations.

6.0 Quality Assurance / Quality Control

Quality assurance and quality control (QA/QC) procedures for the supplemental investigation will be performed in accordance with the prior Phase 2 ESA Workplan and the associated QAPP. QA/QC measures for the supplemental Phase 2B investigation and laboratory analysis are described below.

6.1 Field Quality Assurance/Quality Control Measures

Quality assurance of the field data will be maintained by field team personnel who are involved with the collection and handling of the required data. Each individual is required to perform specific tasks and document the completion of each task. Field quality assurance/quality control for this project shall be maintained by proper documentation of the actual work performed including date of performed work, daily project tasks, sample locations, sample collection times, specific field observations, weather conditions, air monitoring results, and identification of assigned field personnel. Documentation of the work performed shall be in the form of a field log book maintained by the field supervisor.

Quality control of the field data will be maintained through the collection of duplicate, equipment blank, and trip blank samples. Analysis of these samples will facilitate an evaluation of the sample collection and handling procedures, as well as the reproducibility of the data.

One (1) soil duplicate sample will be acquired for every 20 samples collected, or a minimum of one (1) sample every day of field sampling activities, to allow an evaluation of the reproducibility of the data. Duplicate samples will be acquired by collecting a sample volume from a selected location which is equal to twice the typically required sample volume. The sample volume will be split and placed into appropriate sample containers to produce two (2) separate laboratory samples. Each sample will then be identified with a unique sample identification number and submitted for analysis of the same suite of constituents.

Based on the anticipated collection of 11 groundwater samples during the Phase 2B groundwater monitoring event, 1 field duplicate groundwater sample will be collected for laboratory analysis. The duplicate sample will be collected using the same method employed for the field samples. The sample volume acquired will be twice the typically required sample volume. Each sample will be identified with a unique sample identification number and analyzed for the same suite of constituents.

Field blanks will not be collected since disposable sample liners are being utilized for the soil sampling efforts. These liners eliminate the need for equipment decontamination procedures between borings. Similarly, field blanks will not be required for the groundwater sampling efforts since new dedicated

equipment will be utilized for each groundwater sample. Trip blanks will be utilized for groundwater monitoring events in which samples are submitted for laboratory analysis of VOCs.

6.2 Laboratory Quality Assurance/Quality Control Procedures

The selected laboratories (Mid-American TEG and Severn Trent Labs) will perform the laboratory analyses required by the scope of this Workplan Addendum according to the specific procedures described in the QAPP. The QA/QC procedures shall be in accordance with USEPA's SW-846, Chapter 1, Quality Control which addresses such items as laboratory blank samples, replicate samples, spike samples, and instrument calibration data.

7.0 Health and Safety

All Phase 2 ESA investigation tasks performed at the Boeing Facility shall be conducted in accordance with the prior site-specific Health and Safety Plan (HASP) dated July 2000. The HASP will consider conditions relevant to the site and will be reviewed by ESE's Health and Safety Officer. The HASP will comply with the Occupational Safety and Health Administrations (OSHA's) specifications contained in 29 CFR 1910.100. ESE personnel and subcontractors involved in Facility investigation activities will read the HASP before beginning work at the Facility, as well as participate in daily health and safety meetings.

An acceptable health and safety program shall be implemented to protect the field personnel from the potential exposures associated with subsurface sampling. Elements of the Health and Safety Program include:

- Health and Safety Plan (HASP) prepared by ESE personnel in coordination with Boeing safety/environmental personnel;
- 40-hour HAZWOPER training for field sampling team members;
- 8-hour supervisory training for team leader;
- Site-specific safety briefing; and
- Use of Level D protective equipment.

Boeing policies also specify an additional health and safety requirement. All ESE and subcontractor personnel must read the Boeing *Vendor/Contractor Safety/Environmental Awareness Guide* prior to acquiring an approved contractors badge. The approval process must be completed prior to the commencement of any work at the Facility.

8.0 References

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